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Framework For Purposeful Technology Integration In Environmental Education Using Inquiry Based Learning

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FRAMEWORK FOR PURPOSEFUL TECHNOLOGY INTEGRATION IN ENVIRONMENTAL EDUCATION USING INQUIRY BASED LEARNING

by

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INTRODUCTION

Project Overview

With changes in our world that we see every day, and the ever changing policies for caring about our environment, the importance of Environmental Education could never be more important. I want to reach our young generation with something many have in common and is a major part of their world; technology. But many educators are left pondering a broad question; "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*"

Youth of Today

Reaching youth today is vital to ensure continued stewardship and environmental ethics are carried on in future generations. But reaching those youth can be a challenge. Bridging the gap between nature and a technology driven society can be difficult, and at times has left a divide among generations and social circles as to whether technology even has a place in nature. The main drive of my project concept is to investigate this divide and find a reasonable method of intentionally integrating these two worlds. The concept of technology in nature is not necessarily new, but the idea has been criticized as not important or distracting, from my observations. This brings back the basic question

being asked here; "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*"

Technology Today

There are many instances of technology usage for school programs. Some teachers have used iPads to journal, as my site at *Hartley Outdoor Education Center* (Hartley OEC) has done. Others use an iPad camera to take pictures. Each of these techniques has a different element that makes for a unique investigation of nature. Some may argue that the students can simply write notes on paper with pencil, and students can easily draw what they see in nature. Both of these traditional strategies are very valid teaching tools that students can use, and should. However, many youth today have technology incorporated into their life in so many ways that it is in essence part of who they are. To ignore this would be to ignore part of who the youth of today are. Looking at job applications of recent times, you will see that basic computer knowledge is a very common basic skill needed for many different jobs. Adults often joke about how they are having trouble with a phone or computer and that they should give it to the kids to fix for them. If our youth of today are so in tune to various technologies, it is only fair to say that it is a vital aspect of their learning environment as well. The key to making the learning experience effective though is to find a way to apply the technology that students know and use. Then apply this technology in a framework that encourages exploration, questioning and curiosity, rather than giving answers. If we use technology in a manner that encourages curiosity, questions and exploration, we can inspire lifelong students of our natural world.

Personal Connections

Growing up, I was often outdoors exploring my world. I loved discovering all different kinds of habitats and animals. Some of my first memories include looking for small newts at a *Girl Scout* camp in New England. My parents often volunteered for various programs, which meant that I got to be a camp kid growing up around nature. My parents both had developed personal passions for nature and the outdoors even though they grew up in very different settings. My mother grew up with life experiences on a farm, and my father grew up in the city of Toledo, Ohio. With different life backgrounds, nature was still part of their lives in one element or another. From camping and fishing, to horses and crops, my parents' experiences helped shape some of my own upbringing.

Technology was also a major part of my life, as my father is a software engineer. I learned how early computers worked, basic coding, and even had the chance on many occasions to pull apart and rebuild various toys. If something broke, my siblings and I often figured out how to fix it or even improve it, based on what we needed. At one point I had even gathered old computers that were thrown out and rebuilt them for games and school. In a big family, you don't often go out and buy new toys every time one breaks. We did not go without, but we learned to care and respect what we had and to always strive for better. This applied for not just our toys, but every aspect of our lives.

I was homeschooled and very active in several youth organizations. From *Scouting* to *4-H*, I had many opportunities to explore my world and see different aspects about how it all worked. As I grew older, I explored more about how different things were connected. Many of my memories are from Indiana, and later the Michigan. I was

able to experience different cultures and different approaches to nature. From preservation to management, different people had different beliefs on how to care for their environment. I volunteered at *McCormick's Creek State Park* in Spencer, Indiana through middle school and part of high school. I learned how to develop and teach naturalist programs, building maintenance routines and scheduling. Outside duties included field projects such as landscaping. One of my best experiences was being able to help with a controlled burn of an old prairie that resulted in the restoration of native wild flowers in the 90+ acre plot. Here technology started to become a vital tool to taking care of the outdoors. We used hygrometers, GPS, and computers to log data and create reports throughout the whole process of the burn. This first taste of field technology was to be the beginning of a common trend as I grew in environmental sciences. Through scouting and search and rescue experiences, I began to use a wide variety of different tools to investigate the area around me. From topographic maps and GPS units, to photo equipment and radios, I often found myself naturally having both worlds of ecology and technology combined. This changed when I began to get further into my college studies. The two worlds of technology and environmental learning began to draw lines.

I started at Delta College in University Center, Michigan for some of my preliminary courses as I was trying to find where my passion for natural studies was best suited and eventually transferred to *Cornerstone University,* in Grand Rapids, Michigan. I worked toward a Bachelor's degree in Environmental Biology with an interest in education. I had many different experiences with local professors, as well as, outside experiences with off-site learning centers, including AuSable Institute of Environmental

Studies in Kalkaska, Michigan and Universidad Veritas in San Jose, Costa Rica. Each new experience brought new professors and new world views helping shape much of my early career life in environmental education. Some professors used very basic tools to teach about the environment; while others used technology, like electronic probes and transmitters. In 2008, one my professors, Ray Gates from Cornerstone University, shared a very important lesson with me about the learning experience: "To understand what you are learning and investigating, it is vital to learn and investigate who is guiding you through the learning process. Who they are and what their world view is can be a huge part of how they view and interpret the world around them" (personal communication, 2008). He may not have been the most tech savvy professor on campus when I met him, but he made an effort to reach out to students at a common ground. This common ground is a part of the respect system between teacher and student. Helping students grasp concepts in a tangible and relevant method is key to helping them continue their curiosity and passion to learn and grow.

Professional Reflections

Through my professional career, I have seen a wide variety of different levels of technology usage by adults and youth alike. I teach at both the Bay City State Park visitor center, and for Hartley OEC. Each site gives me the chance to see how different audiences approach the natural world. For some, it may be as familiar as their own backyard. For others, it may be their first time seeing a squirrel. Interestingly, there are some similarities and differences observed between urban vs. rural upbringing in the Saginaw Valley area. Some urban families rely on the river for fish as part of their diet;

whereas some of the rural families may rely on white-tailed deer for part of their diet. And still some families have neither experience and yet still love to go camping, biking, boating, or one of many other outdoor experiences. Nature can look very different for people even in the same community. One common factor that the youth seem to have is this fascination with smart phones, cameras, internet, and all the latest technologies I have yet to come across. With such an interest in technology among my students, this seemed to be that common ground I had been looking for.

Technology Ideas

I began finding different technologies that students could use for the classes I was teaching. IPads was a logical choice that was incorporated into classes at *Hartley OEC*, but it was not widely accepted for a number of different reasons. The first opposition was the idea of technology in nature. For some visitors, being in nature is supposed to get the student away from screen time and video games. Since IPads often are used for games by youth, it is a common belief that the IPads would be used the same in a natural setting and remove the direct touch and experience. Views of how the iPads were already being used were what the opposition could foresee as the iPad's role in a natural setting. At times they seemed to be right as I observed the students; looking down at a screen taking notes and selfies with the camera that was built into the device. Then I took a step back and reflected on that moment for a second with an open mind. The students not only were taking notes, but they found another tool they could use to document the trip; Cameras built into the device were being used as part of their adventure. So now they had two forms of technology to record the experience from their personal discovery. What else

could this tool be used for? Turns out, there are lots of applications available for download that can be used on the iPad to help students explore nature. The question was; would the applications be a distraction or simply a game that the students are using in nature? Or is the application actually helping the outdoor experience to facilitate a raw discovery that encourages more questions about the world around them? This goes back to my project question, "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*"

Too often teachers can find themselves reciting information to students that was recited to them. This repetition or passive approach to teaching has taken the learning experience to what seems to be a dead end. A question is raised about a subject and the teacher gives the answer. A growing concern is that we are not encouraging the students to question the subject matter and further develop their literacy of the material or subject at hand. As teachers, are we even facilitating an environment that allows for student investigation? Having a raw experience to explore questions students may have, can encourage a healthy curiosity to dig deeper. This raw, student-led learning experience should also be modeled when using technology. Creating a framework or model to facilitate this opportunity is the primary goal of the project.

Bring Experiences To Application

Through all the different experiences I have had over the years, I have seen that there can be a wide variety of worldviews, opportunities, tools, and lessons that can be applied to the care of our environment. Incorporating them into a sensible working

system can never be easy, but is vital to understanding the complexities of our world. Just as I learned in my early years of life, the natural world can have many different components to a habitat. Each component is, very unique to the last and yet still vital to the whole of the unit. Technology, I believe, is yet another intricate piece of the learning unit that, when applied appropriately, can be a major asset to the whole learning experience. Creating a raw learning experience is to use the technology in a manner that invokes investigation. A simple borescope is a tool that can be used to explore the hole in a trail on a nature walk. This can be an interesting experience, but the framework has to allow this technology tool to turn the one question into an investigation of other future investigation. We don't want to simply answer the question, but creatively think about how they can answer their own questions with their knowledge and tech experiences. Here is the most challenging part of the teaching experience; facilitating inquiry-based learning that has students relating to their lives and technology experience to better address environmental questions or problems so they can find the answers for themselves. I often feel as a teacher that I am supposed to have all the answers, but the concept here is allowing students to analyze the situation to solve their own questions or problems using tools with which they are familiar.

Reaffirming the Project

The purpose of the project is to address just such a challenge posed to our educators. "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*" The framework developed from this project, with models that have been created to address the

needs at Bay City State Park and Hartley Outdoor Education Center, is to serve as a guide for other environmental educators to help them develop projects for their students, specifically tailored for their areas. The framework is meant to be very raw to allow flexibility with each unique design according to the educators needs, yet have enough outlining to guide an educator with an idea concept through steps to creating their own program module. Students can come to the experience with many different learning needs. As educators, we have to have a flexible system to meet those individual needs as they arise, to reach our students effectively. The models serve as examples that I have created for my personal area, learning objectives, and student groups that can assist educators as they develop and grow their own programs. Hopefully it will inspire others to utilize these models and develop them further, just as we encourage our students to take their learning beyond the initial learning experience. In chapter two I will address the specifics behind the need of technology integration in environmental education and the need for both in our education system. I will also cover aspects of the pedagogy behind the framework with reference material. Chapter three will cover a more indepth look at the project and the methods used for the development.The chapter will also cover some considerations for the framework when utilizing it for designing a program.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter serves as a background guide to understanding the project question: "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*" The following sections will help to understand the concept of Environmental Education, new and changing pedagogy in education, and explore the types of technology application that could be suitable for the scope of this project. The overall goal is to develop a framework incorporating these three key parts that could be utilized by future educators as a guide to develop their own program concepts that are site specific.

Chapter Outline

The purpose of investigating the background of Environmental Education is to help develop an understanding of how Environmental studies have come to be and briefly explore where those studies are taking us. Establishing the focus of the study will help to develop a mindset for the second section that deals with framework of the program.
To understand how to effectively apply Environmental studies, we need to develop an understanding of our audience. Through examining different pedagogies of student

learning, we can begin to create a framework concept that fits not only the subject matter, but most importantly, a framework that helps facilitate a student-centered learning experience.

Since the learning experience is to be student-centered, technology is a tool that can help educators connect with a younger audience. But the technology to be used cannot be merely "thrown in", rather, it must be purposefully utilized in the learning experience and use technology that is not only familiar to the audience, but also a stepping stone to tools that professionals may utilize in the field. Staying within the focus of the project question though, is that the tools must be used for raw data collection and exploration.

Environmental Education

The study of Environmental Education (EE) has two parts that blend together as a whole for understanding our world. Some programs look at just the science study aspect of the environment they are part of, drawing data and facts for logical analysis of environmental issues. The second part would be the social aspect or impact of the environment and the response by the citizens. "Environmental Education (EE) is a process in which individuals gain awareness of their environment and acquire knowledge, skills, values, experiences, and also the determination, which will enable them to act - individually and collectively - to solve present and future environmental problems"(Srinivas, para. 1, 2018). Citizen science programs are designed specifically to help bridge the two gaps of scientific data and social impact along with research biologists and general public. "Citizen science can raise people's understanding of science while helping scientists conduct their research" ((Ruiz-Mallén et al., 2016).

The Environmental Protection Agency

The United States Environmental Protection Agency (EPA), started in 1970, was created to help establish protection programs, enforce environmental protection policy and laws, as well as educate the public about such concerns. At a time when environmental stability was eroding, a call for correction was made in the works by Rachel Carson's *Silent Spring*. This awakening of our understanding and recognition of negative environmental impacts people had been making was a driving force to call change in how environmental policy should be handled; which later resulted in creation of the EPA. The EPA describes Environmental Education (EE) by saying,

> Environmental education is a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment. As a result, individuals develop a deeper understanding of environmental issues and have the skills to make informed and responsible decisions. (What is Environmental Education?. 2012. para. 1)

This idea of literacy and action are crucial pieces to understanding environmental issues. The EPA further points out components that break down the concepts to EE:

- *Awareness and sensitivity* to the environment and environmental challenges

- *Knowledge and understanding* of the environment and environmental challenges

- *Attitudes* of concern for the environment and motivation to improve or maintain environmental quality

- *Skills* to identify and help resolve environmental challenges

- *Participation* in activities that lead to the resolution of environmental challenges

Recognizing the role of the NAAEE

The North American Association of Environmental Education (NAAEE) believes that since many aspects of our lives are dependent on the environment (About EE and why it matters. 2015. para. 4); we have to incorporate the learning of and care of it at every age level of society. The methods used to teach learning, understanding, and caring though are not always viewed the same. Some organizations may present endangered wildlife, while others point out environmental disasters. The negative approach could cause more harm than good (Sobel, 1996). Sobel, from *Beyond Ecophobia: Reclaiming the Heart in Nature Education,* talks about how presenting a negative type issue may actually cause young minds to distance themselves from the subject. Rather it is better to take the approach of nature with a sense of empathy. The second level is described by Sobel as "exploration" (Sobel, 1996). Here students go beyond the 'Who' of the environmental story, and uncover the 'Where' questions. The third is "social action" (Sobel, 1996). Now students start engaging at a higher level to answer the hard question of 'Why' and develop the means of answering the 'How'. Each stage builds on the last to create a "Life Long Learning: Cradle to the Grave" (About EE and why it matters. 2015.

para. 5) approach to teaching the subject. Having an awareness or literacy for the environmental world is not an overnight process. Through a development of knowledge and skills, people become more and more engaged with the processes of their environment. But is Environmental Education for everyone everywhere? Often when a person thinks about Environmental Education, they tend to think about nature centers and parks. NAAEE believes that there are aspects of Environmental Education for many different cultural groups. "Our personal and cultural identities are often tied to the environment around us. At the same time, it's impossible not to be deeply concerned about the unprecedented environmental, social, and economic challenges we face as a global society" (About EE and why it matters. 2015. para. 2)

Different programs have been developed to address different social and cultural application to the field of EE. One example of this is called *Urban Environmental Education* by Cornell University in association with NAAEE (Russ, 2015). UEE is only part of the learning process as well. NAAEE recognizes that there is a wide learning style range and highlights some main points,

- Focus on systems thinking
- Lifelong learning: cradle to grave
- Focus on sound science
- Built on a sustainability platform
- Interdisciplinary
- Sense of place

- Reflects best practice in education (learner-centered, experiential, and project-based learning)
- Informed Decision Making (About EE and why it matters. 2015. para.5)

These points help illustrate the complexity and broad possibilities that EE can have in a learning community.

Pedagogy

Trying to develop a framework for student learning requires understanding of the student to teacher relationship. “Children develop science knowledge as they observe and act on the world, asking questions, making predictions, testing those predictions, and reflecting on their experiences learning happens as they construct continually more sophisticated theories of how the world works” (Worth, 2003, pg. 9)

Students learn in different ways and the world of teaching is filled with several models of student behavior in different settings. Selecting the right model may not always be the easiest task for a teacher. For this reason, part of the project is to identify some of the more effective models that are best suited for Environmental Education. Part of making the experience effective is by understanding the audience. Student-Centered Learning, as described by Great Schools Partnership is the initial stance to help determine a suitable model.

> The term student-centered learning refers to a wide variety of educational programs, learning experiences, instructional approaches, and academic-support strategies that are intended to address the distinct learning needs, interests, aspirations, or cultural backgrounds of individual students and groups… to

> accomplish this goal, schools, teachers, guidance counselors, and other educational specialists may employ a wide variety of educational methods, from modifying assignments and instructional strategies in the classroom to entirely redesigning the ways in which students are grouped and taught in a school. (Great Schools Partnership. 2013. para. 1)

Kolb states, “Learning is the process whereby knowledge is created through the transformation of experience” (as cited by McLeod. 2017. para. 4). This concept is put into a 4-stage framework model.

> Effective learning is seen when a person progresses through a cycle of four stages: of (1) having a concrete experience followed by (2) observation of and reflection on that experience which leads to (3) the formation of abstract concepts (analysis) and generalizations (conclusions) which are then (4) used to test hypothesis in future situations, resulting in new experiences. (McLeod. 2017. para. 6)

This system allows for a continual education model that incorporates building on knowledge in progression and reflection that makes the study applicable to the student at a personal level. This fits the concept of student-centered learning.

Applications of Student-Learning

Open framework and student-led investigation have been a popular direction for many environmental educators to build on. The study focus tends to follow that of a mixed method approach, “Integrating quantitative and qualitative data collection and analysis in a single study or a program of inquiry” (Creswell, Fetters, & Ivankova. 2004.

para. 5), to better engage the students in a sustainable approach to what is better known as Citizen Science learning (Louise, 2018). Citizen Science has become a popular tool to bridge the gap between general public and researchers. The concept addresses the need to gather raw data from a broad research area by organizing basic training and empowering citizens to collect the data through different methods for research. This allows for a much broader collection area while engaging the public in an action-based experience. Through the course of the experience, participants become knowledgeable about the subjects and begin asking questions about the subject once experience has established a sense of literacy in the individual. This follows the second and third steps to the experiential learning cycle discussed previously. The blending of different learning models seems to be part of this framework. Inquiry Based Learning, Place-Based Learning, Backward Design, and Student-Led Projects are all popular buzz words used to describe many trending educational learning models and curriculum programs that seem to fit a Citizen Science project model.

Buzz Words

Student-led projects are fairly straight forward in that they are investigations or experiments that are mainly developed and conducted by the students themselves. This concept is embodied in the concept of inquiry-based learning. The concept of inquiry-based learning is derived from John Dewey who believed learning came from personal “real-world” experience and student inquiry (Cox, 2015, para. 1). Janelle Cox further explains, in All About Inquiry-Based Learning article from Teacher Hub, that,

Since inquiry-based learning is based on getting students to ask questions, it's essential that you, the teacher, are able to model inquiry effectively. Research suggests asking four types of questions: Inference questions, interpretation questions, transfer questions, and questions of hypothesis. (Cox, 2015, para. 4)

(The Key to Effective Questioning)

- **Inference questions.** These are questions that ask students to think beyond the information that is available.

- **Interpretation questions.** These questions propose that students have an understanding of the consequences of the information.

- **Transfer questions.** While inference and interpretation ask students to think deeper, transfer questions ask students to take their knowledge and use it.

- **Hypotheses questions.** These are questions that make students predict and test their knowledge.

- **Questions need to be something that students care about.** Remember, students will be coming up with questions themselves so they need to be something that they care about or are interested in finding out.

- **Questions must be answerable.** If you are having a discussion about a book you are reading in class, a question such as "Why did the author write the story?" can

be an effective question if the answer exists and the students can find it, or if they have a strong opinion about it. If you ask a question such as, “Why did the author write the last paragraph in way that they did?” students will not be able to answer this question, because they are not the author.

- **Answers should not be a fact.** “What year did Rosa Parks die?” This question can simply be found on the internet in a matter of seconds and does not make a compelling question. “What factors caused Rosa Parks to die?” would make a compelling question because students would have to research this information.

- **Questions must be objective.** Questions such as “What does evidence suggest?” or “What do scientists believe” can objectively be answered. But, a question such as “Which play is better, __ or ___?” Cannot be objectively answered.

  Cox, J. (2015)

This concept of asking questions and investigating can become as formal or open as you choose it to be. Some of the best investigations can come from simply playing (Marian & Jackson, 2017). This basic inquiry and exploration of the real world allows early education learners to develop the skills of questioning and investigation, which can lead to, “predictions, negotiations, discussions, reasoning, and problem-solving” (Marian & Jackson, 2017).

Backward Design

Backward Design is a concept described through Understanding by Design (Wiggins, 1998). It is a curriculum framework that utilizes Essential Questions described,

through inquiry-based learning, as effective questions. The whole of the concept is known as Understanding by Design Framework (UbD Framework) and includes all aspects of curricular design that helps for outlining outcomes as well as assessment needs; developed by Jay McTighe & Grant Wiggins (Wiggins, 1998). The framework helps to build on a central theme with questions that lead the teacher to further develop the lesson that can help guide students. The purpose is to cause students to draw meaning from an experience rather than from a text. Backward Design incorporates "7 Key Tenets" (Wiggins, 1998, pg. 1-2),

1. Learning is enhanced when teachers think purposefully about curricular planning. The UbD framework helps this process without offering a rigid process or prescriptive recipe.
2. The UbD framework helps focus curriculum and teaching on the development and deepening of student understanding and transfer of learning (i.e., the ability to effectively use content knowledge and skill).
3. Understanding is revealed when students autonomously make sense of and transfer their learning through authentic performance. Six facets of understanding the capacity to explain, interpret, apply, shift perspective, empathize, and self-assess can serve as indicators of understanding.
4. Effective curriculum is planned backward from long-term, desired results through a three-stage design process (Desired Results, Evidence, and Learning Plan). This process helps avoid the common problems of treating the textbook

as the curriculum rather than a resource, and activity-oriented teaching in which no clear priorities and purposes are apparent.

5. Teachers are coaches of understanding, not mere purveyors of content knowledge, skill, or activity. They focus on ensuring that learning happens, not just teaching (and assuming that what was taught was learned); they always aim and check for successful meaning making and transfer by the learner.
6. Regularly reviewing units and curriculum against design standards enhances curricular quality and effectiveness, and provides engaging and professional discussions.
7. The UbD framework reflects a continual improvement approach to student achievement and teacher craft. The results of our designs, student performance inform needed adjustments in curriculum as well as instruction so that student learning is maximized.

   (Wiggins, 1998, pg. 1-2)

The concept certainly does offer a flexible design to incorporate inquiry learning beyond the textbook; but a key format piece needed to show the use of Science, Technology, Engineering, Art, Math *STEAM,* (What is STEAM?, 2014), to actually intentionally incorporate the different elements into the program, One of the most important being technology, which is the primary objective of this project question: "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*"

Technology

Many youths today are connected to technology in one form or another. Often educators are looking for that one thing that will engage their students in a learning experience, resulting in a lesson that has a lasting impact. But an educator also wants that experience to be a purposeful experience rather than just something that is added as an extra step or activity. Technology can be a major gap closer for the learning world when used in an effective manner.

> According to the U.S. Census Bureau, in 2009, 31.3% of households did not have computer and/or Internet access. This number is higher for African American (45.5%) and Hispanic (47.2%) households. This means that many students rely on the school setting to provide them with the necessary technological practice to prepare them for success as they go through the school system and prepare for the workforce or higher education. For young children, this includes becoming familiar with technological terms and the use of different hardware and software. (Willis, 2015, para. 6)

In addition to general real-world application, the angle of technology has also been found to be extremely beneficial to connecting to the program framework of having a student-centered experience.

> Technology can address different learning styles by helping students understand their experiences through verbal, written, spatial, quantitative, and/or graphical means. Technology also can motivate children to become independent thinkers by offering opportunities for student-centered instruction, or technology can be used

> to promote cooperative learning and increase the interaction between the teacher and the student. (Willis, 2015, para. 7)

The goal of the technology used in this project is to facilitate discovery of environmental phenomenon. Students can employ technology tools to help answer the questions they may have about the environment rather than merely accessing a database of answers. The use of the technology also helps students reflect on their findings in different formats allowing for self-expression to better illustrate their findings.

Technology is not always accepted in environmental education. Often, a common thought referenced from Richard Louv (2006), is that children need direct nature experiences or they will develop "nature-deficit disorder". Subsequently, the purpose behind the project is to incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in environmental education. Too much screen time has been a major concern for many groups, but what is meant by "screen time"? In general, the concept is how the technology is used and how it isolates an individual from their surroundings. The American Academy of Pediatrics (2018) states, "Problems begin when media use displaces physical activity, hands-on exploration and face-to-face social interaction in the real world, which is critical to learning." AAP further explains that, "What's most important is that parents be their child's 'media mentor.' That means teaching them how to use it as a tool to create, connect and learn" (AAP. 2018. para. 3).

Technology as a Tool

The main idea is that if we want to make use of various technologies in education, we need to examine how the tech is used and how long it is used compared to the overall project. As mentioned previously, when using technology, you have to be mindful of how you use it so that it will not disrupt the student's face-to-face interaction time, "which is critical to learning"(AAP. 2018. para. 3). This can be addressed by formatting the time spent with an item as a small group or large group activity. Although it can be nice to have students each have their own tool, it can be very beneficial to have students share a tool, which will result in them sharing the experience and working together to troubleshoot any obstacles that may occur. The North American Association of Environmental Education (NAAEE) cites technology as helpful when used appropriately:

> Educators can integrate technology and media with environmental education through activities that encourage children to explore, create, problem solve, communicate, collaborate, document, investigate, and demonstrate their learning about the world outside of their classroom. We argue that developmentally, appropriate technologies can be used to supplement experiences in the natural world, especially when the curriculum
>
> 1. is based on research and theory,
> 2. integrates authentic experiences
> 3. is child-directed and inquiry-based, and
> 4. relates to the whole child (Willis, 2015)

The application of technology needs to be monitored. As Willis points out in *Bridging the Gap: Integrating Technology and Environmental Education* (2014. para. 8),

In order to introduce technology in age-appropriate and educationally effective ways, the National Association for the Education of Young Children (NAEYC) and the Fred

Rogers Center recommend that early childhood educators:

- Select, use, integrate, and evaluate technology and interactive media tools in intentional and developmentally appropriate ways, giving careful attention to the appropriateness and the quality of the content, the child's experience, and the opportunities for co-engagement.
- Provide a balance of activities in programs for young children, recognizing that technology and interactive media can be valuable tools when used intentionally with children to extend and support active, hands-on, creative, and authentic engagement with those around them and with their world.
- Prohibit the passive use of television, videos, DVDs, and other non-interactive technologies and media in early childhood programs for children younger than 2, and discourage passive and non-interactive uses with children ages 2 through 5.
- Limit any use of technology and interactive media in programs for children younger than two years to those that appropriately support responsive interactions between caregivers and children and that strengthen adult-child relationships.

- Carefully consider the screen time recommendations from public health organizations for children from birth through age five when determining appropriate limits on technology and media use in early childhood settings. Screen time estimates should include time spent in front of a screen at the early childhood program and, with input from parents and families, at home and elsewhere.
- Provide leadership in ensuring equitable access to technology and interactive media experiences for the children in their care and for parents and families.

Another aspect of the technology is to consider what is the tech tool that is being used? Often the studies and negative implications of technology use are referencing media usage. The AAP has recognized that media has been the major issue and announced a family guide to help navigate parents through mentoring youth using the *Family Media Use Plan* tool launched in 2016 at healthychildren.org. One of the first steps to developing the program concept is to identify if the technology to be used is some type of media or non-media technology.

Common technology ideas for environmental education include using apps for reporting data through *Citizen Science projects*, or video journaling on an iPad or tablet. These seem to tie into the concept of media connection. Many of the apps seem to record data and observations like a journal. “Smartphones can automate data collection and incorporate many important data-gathering functions—such as capturing images, audio and text—into a single tool that can “stamp” the date, time and geographic coordinates

associated with an observation"(Malykhina. 2013. para. 2). An example of this journaling is shown in the Secchi disk app portion:

> Participants create a Secchi Disk, which is a tool to measure water turbidity, and use it with the Secchi app. This simple piece of scientific equipment can be built using plywood, plastic or metal, painted white. Attached to a measuring tape, the Secchi Disk is lowered into the water until it disappears from sight—a process for estimating the amount of phytoplankton. The depth is then recorded on the Secchi app and uploaded to a database. (Malykhina. 2013. para 6)

This illustrates how the app can be very helpful to record data, but it is not the actual tool used for discovery. The purpose of the "tool" concept needs to be one that enhances our own physical exploration. Binoculars help us to visually observe further. Trail cameras capture images for extended times. Digital pH meters help to actually test the water or soil sample.

Identifying technology to fit the "tool" concept

What might be useful tools to incorporate into a project can be found in several different areas. First, we can look at what professionals use when doing a research project. It is important for students to grasp some basic skills as youth so that they may build and grow on those as they further develop, so as to stay current. Often technology advances can happen at a quick pace. If I were to mention skills using a remote controller, I might have people thinking about video games. Reality is that those same skills apply to several tools used by professionals.

From drones used for Geographic Information System Mapping Technology (GIS) to robots, mini subs, and even in the medical field for specially guided robots, there are many places controllers are used. Drones, as an example, are a tool that must first be practiced and understood in order to grow.

> Various programs and universities are working to integrate drone technology in an active way into what students are learning in the classroom. Doing so isn't just about using drones though, because the reality is that UAVs will soon be thought of as just another tool. Before that happens, professionals will need to have a nuanced understanding around how the technology can be leveraged, and that's exactly what's happening in courses at West Point and Virginia Commonwealth University. (Karpowicz. 2016. para. 2)

Sound is another way we can observe. Tablets can record different sounds to be analyzed, and various attachments can aid in this process. *Wild Acoustics* is a company that specializes in such tools, like many others to investigate audible observations. The sound bats make is one such sound that can often be difficult to hear and differentiate from others sounds. Like binoculars, these devices aid in the discovery process rather than simply journaling the observations. This agrees with the models described previously with Willis (2014) describing different tools to capture observations, but now incorporates sounds as an isolated investigation from picture or video capture.

Summary

These technologies are just a couple examples of possible applications. The purpose of the project is not to identify all the possible technologies out there, but to

provide examples of some that closely apply to the goal of the project. Again the project question being addressed here is, "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*"

With the class concept being student-centered, a second source of ideas is the youth themselves. Using what the students already know makes it that much stronger of a connection for the student. Letting the students develop a study method and adapting the technology they are familiar with to address the study is part of the learning concept that the project hopes to inspire. Often times the ideas can be loose and half finished, which is the reason why the framework developed for this project, similar to backward design, is so important for educators, to help shape their concepts with their students and show the student how to incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education. The following chapter will outline a more detailed view of the project and address content areas regarding the methodology, audience, ethics, and the description of the project. Each part helps to build on the other to understand the concept of the project and the considerations going into using the framework. Chapter four will then reflect on the project and the possible directions the project can go to further grow and be utilized in developing programs.

CHAPTER 3

PROJECT DESCRIPTION

Introduction

This chapter will better address the specifics of the capstone project by focusing more on the specifics about the proposed framework and modules while looking at the overall capstone project question of, "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*" I will also address the setting for this type of programing and more specifics of the typical audience that the individual lessons are created for using the framework that is developed.

Overview

Technology and Environmental Education can often become two separate studies, and from my experiences in schools and nature centers, can often even be considered opposites. This leaves many educators thinking similar to my capstone question, "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*" To address this gap, I developed a framework to guide educators in effectively utilizing technology in their program as not merely an added piece, but as an intentional part of the lesson. This framework also is modeled in three individual lesson samples that cover three different

technologies used at three different age groups to help demonstrate the concept of the framework. These lessons will also serve as new classes for my personal worksite to help introduce local educators to the framework concept and use of technology. The curriculum utilized for development of the modules follows the national standards known as Next Generation Science Standards found at https://www.nextgenscience.org/.

Project Methodology

With many youths highly engaged in technology, and most career fields utilizing technology, it is an important element to establish in Environmental Education. Different technologies can offer opportunities for several different learning styles for a more "student-centered instruction" (Willis, 2015, para. 7). Incorporating flexibility and STEAM elements "Science, Technology, Engineering, Art, Math" (What is STEAM?, 2014) helps make technology an integral part of the lesson. Helping to keep this concept and establish a framing for the lesson, The Backward Design Framework (Wiggins, 1998) helps to direct the educator to identify an outcome for the lesson while keeping flexible on the method or "skills" needed for achieving this outcome, allowing for student discovery through the process.

Setting & Audience

The framework for this project is developed to be utilized by a wide variety of educators of K-12 grade levels. This not to say that the framework could not be utilized in a different setting, but for the purposes of this capstone project, and for the design of the three modules that are described, I will focus on that range of students. The setting for the program too is open in that environmental learning can take place both in the

classroom and outside the classroom. The modules that I have designed are for non-traditional education settings that can be used at my personal site that have an outdoor experience such as a hiking, habitat exploration, or similar type setting. This outdoor setting could be at a park, school property, or a number of other properties at the choosing of the educator.

Project Description

The project consists of two parts. The first is a framework type outline that can help an educator lay out the parts of the lesson concept that they hope to achieve. This framework also consists of several educational template elements to create flexibility and a Student-Centered Learning Experience (Partnership, 2013). The second part of the project will consist of three lesson examples that will be used for my local worksite. These lessons will consist of three different technologies used at three different grade level groups to help demonstrate the concept of the framework.

The overall framework includes several different learning methods and frameworks. The first learning model is the STEAM model which consists of the elements as described by *Educationcloset.com* as being "Science, Technology, Engineering, Art, Math" (What is STEAM? 2014). This national initiative for education learning connections emphasizes the importance of technology as being an intentional part of the learning process. The second element of the framework includes the concept of Backward Design Framework (Wiggins, 1998). This framework helps establish a flexible framework for different learning styles while also incorporating a Student-Centered class design (Partnership, 2013).

The finished product is a template that an educator can fill in to initially draft the lesson concept. This is accompanied with a lesson assessment and journal templates to help evaluate the lesson design as the class is utilized. The assessment and journal helps the educator to ask question behind the reasoning of the selected elements as well as help guide them to stay consistent to the concept of the framework and effective in their educational goals they have laid out.

The first of the three lesson modules planned focuses on the K-5th grade group, following consistency of the NGSS format of the breakdown of standards. The purpose of the lesson is to utilize a very basic tool known as a borescope. The application of this tool acquires raw data from students simply exploring their natural surroundings. Students may ask questions like, “Is that a snake hole in the trail?” This then lets them take the next step to explore that question as part of a unit that could be about life cycles.
The second unit is designed for middle school, 6th-8th grade. The tool used here is called an Echo Meter Touch 2 tool by Wildlife Acoustics. This tool helps identify bats that maybe in the area. The students can collect data about a species or group of species and graph out the results. This will also open the doors for deeper thinking opportunities including Endangered Species, wind turbines, people who are blind, and many others for small or large group discussion.

The third lesson is created for high school, 9th-12th grade. The tool used here for this group will be a drone. The application of a drone is widespread in the workforce today in many different applications. From military use to mapping and videography, drones can be used to gather lots of information and can be designed various ways. The

lesson will allow for use of the drone, collection of raw data to be discussed and the connections to environment impacts that may be occurring in the area based on their findings. This high-level thinking can be organized in several ways to include small and large group discussions and debate.

Timeline

The project was completed over the summer season while allowing time to test out different tech applications and work with specialist to identify the best application of the tools. This also allowed public programing to test out tools acquired, to observe interactions with the tools to help better identify appropriate application and timing for the lessons to be developed for the following school year.

Ethical & Cultural Considerations

The generalization that youth have access to technology or that youth are all knowledgeable about various technologies is something that needs to be examined.

> According to the U.S. Census Bureau, in 2009, 31.3% of households did not have computer and/or Internet access. This number is higher for African American (45.5%) and Hispanic (47.2%) households. This means that many students rely on the school setting to provide them with the necessary technological practice to prepare them for success as they go through the school system and prepare for the workforce or higher education. For young children, this includes becoming familiar with technological terms and the use of different hardware and software. (Willis, 2015, para. 6)

This statement is an essential element to the importance of the subject material, but also an underlying learning curve an educator must acknowledge and evaluate when developing a lesson for a certain group. Pre-knowledge and certain skill sets may be required or incorporated into a lesson. This could be true for either the student or the educator as well. It is advised that when developing a lesson, an experienced individual should be identified to help guide the educators and students for the project. This may seem like a hindrance, but actually can become an asset to help with training. Other possibilities could include assistance with not only material or financial assistance, but also a community connection to real world job application and career readiness training.

Summary

In short, the project incorporates a vital learning element of Technology into Environmental Education. But I would like it to address the capstone question of. "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*" Technology is a critical learning tool that can have huge amounts of potential if applied in the right manner; that is to say, an intentional application to the learning process rather than simply a mere addition to the program. The program must also be a flexible experience to allow student to explore and ask questions about their surrounding world to become environmentally literate. The next chapter will give detailed accounts of the development of the lessons and the challenges that arose with utilizing the technology with a group. I also plan to explain some of the variables that might arise while using the framework and how to address or make note of this when developing a lesson.

CHAPTER 4

CONCLUSION

Introduction

This project is a piece long coming to our center to help take the next step into Next Generation Science Standards and the STEAM program. Technology has always been an important element in my life, and to see how it has become absent from my work site makes the drive for integration so much more important. But not just for me to incorporate into our worksite, but I wanted to find a way for all the staff to develop their ideas as well. The question that stop us was, "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*"

Project Process Reflection

The first few parts to the process were ok. I had started with some technology ideas that I wanted to use at my worksite and build them into working components for our programing. Working with different people on the project helped to build different views of how this project might come about. The framing of the class needed to have a few different elements, but the exact elements I needed still became a challenge.

Part of the framing concept refers back to a template design I had created back in a previous class when developing STEAM programs for young elementary students. The concept broke down the different disciplines and analyzed each section to align with key

learning objectives and core standards, like those from NGSS. But I also need to find other standards for our state to included technology usage in the classroom. Previous searching turned up old documents. But after talking to a few others from curriculum development and similar fields I was able to locate the Michigan Educational Technology Standards, also known as MET standards. These helped build even further on the project and give it more focus.

Support for the project development though locally was very thin. Although many wanted to give two sense to help spark an idea, many left it as that. My first advisor was not available to review work and so it left me out. But after working through the material and pushing through other life challenges, including taking on a new full time job I had been waiting on applying to for over 8 years, I started to reevaluate what I needed help with for the project. I had first asked for help or expertise with technology application, but what I really needed was advise about curriculum development. This led me back to my supervisor Eric Rutherford and some of the work we had been doing on the classes at the Hartley Outdoor Education Center.

Different parts of the project were originally from our work with the curriculum, including the Program Development Assessment. This frame was a good piece, but had to be modified to address certain important elements. The elements included STEAM component identification and curriculum application breakdown, assessment strategies, and program outlining to include multiple elements. each of these helped to develop the necessary elements to be combined into the Program Design Framework. A template that outlines the different elements in a chart that could be easily read by a teacher or

administrator that was looking for particular elements to evaluate the appropriateness for their learning needs for the class.

Developing these elements into a logical system was half, but the guide I wanted to develop seemed to still be lacking elements. So I developed three other tools to help with the program design guide. The first was the Technology Tool Evaluation Survey (TTES) which is a set-by-set process to analyze a tool and create a index card of the tool so one could file it and refer back to it when developing another class, purchase parts, or any other similar need. The second tool is called the Program Effectiveness Evaluation Tool (PEET) to help summarise the positives and negatives of the developed class. It is a working document that can be added to as you go to help build an adjust the program over time. But after creating it, I realized I needed another element to the project. So the third tool is called the Journaling Evaluation Tool (JET). This is a simple template to fill in after completing a class. It is a modified document I created from one of my development goals from Hartley. I needed a way to reflect on classes and record it so I could look back at what worked and what didn't do so hot. These different elements took some time to create, and with the new job requiring extra work and making a day's shift become 12-16 hour shift days, the process became a very slow pace.

The last few elements that had to be developed included three modules I had originally started and wanted to create very basic examples to demonstrate the application of the different tools while providing some starter inspiration pieces for developers as well as my own site. These took a little time to format the right way as the spacing and page formatting kept becoming misaligned as I modified or developed other sections.

Overall though, I am happy with how it has come out. I know there is more I could do to improve it, but as my advisor had mentioned, it will always have more to improve. The manual is an ever changing piece that will grow. Even major books get revisions as we grow and learn more. So I have to start somewhere, and this version is my first step.

Reflecting on the Literature

Looking back at parts of the literature in chapter two, I see elements that I tried to touch on and had to reflect back on to make sure I was staying aligned to the project I had outlined in chapter 3. John Dewey is one that I referred back here and there with the idea that what the students do for activities needs to be able to apply back to their lives and the working world. Learning something is one thing, but having meaning latter in their life is what makes it lasting. It creates that memory of a lesson learned that can pop up again in life. Janelle Cox is also a major inspiration to refer back to when trying to develop the development and assessment parts. We are not simply looking for right answers, but listening for right questions to be asked. Student literacy in the material is marked with questions that evoke curiosity and inquiry into the subject matter. Each new idea brings more questions and intern creates new ideas and new questions. It is an ever growing and changing process when using essential questions that drive an investigation or learning experience. This ties back to the “7 Key Tenets” (Wiggins, 1998, pg. 1-2).

The learning process is an ever changing and adapting element. As Wiggins describes in the text, there are changing elements all the time. Just as we ask our students grow and adapt, so too should or curriculum and teaching styles grow and adapt to the students needs. I the overall concept of curriculum is that it should be an asset to the

learning experience and not the main focus. The true learning should come from the experience of discovery. Trying and exploring ideas is what fuels the curiosity of the student.

Project Considerations

The project has some elements that I debated about creating or adding, but believed to be unnecessary elements that served no real additional value to the guide. Adding elements like assessment pages for the individual classes and other pieces would be different from group to group or grade to grade and are not necessarily part of the framing. An assessment for a kindergarten student will look very different from that of one I would give a 2nd grader, even though they are not that far apart in grades. This would tie back to developmentally appropriate practices.

The style is very basic as well. This allows a developer to be able to use the digital raw version to modify for their personal needs. Although the idea is fairly good, there will always be different aspects that may need to be tweaked in it to fit the mission of a facility. The hope is that the project would be picked up by various educators to be utilized in helping them develop their class ideas.

One last aspect about the project I wanted to highlight was the order of some of the material. I chose to show the example first and have the breakdown of the elements second so that the reader or developer could see the project as a whole and have that image in their mind as the template or tool is dissected in the overview. This helps to understand how the different parts fit as a one whole connected piece rather than several

little bits. Like many of us have learned, we see a huge project and then take it on one bite at a time.

Next Steps for the Project

The next steps for the project is to introduce it to the staff at my facility and begin seeing how they use the material. As I had said before, it will probably having tweaking as different people approach their own challenges and unique situations. But by having this guide will give them direction to reevaluate our aging programs so that they can be updated in a way that allows for continual growth and change as time and technology or learning changes.

Application of the class modules will hopefully be integrated into this upcoming fall seasons classes as we craft custom classes for our different schools that are gearing up for the new school year. The basis is set, so now it gives some direction for other ideas that I have had with these tools to be used in different ways. But, as I said before, they are to create options. Keeping things open for teachers to integrate is part of it, but I hope to use these classes to also help teachers to create a learning experience with less reciting of knowledge and more student-led learning through inquiry based projects.

Summary

In short, the project incorporates a vital learning element of Technology into Environmental Education. It helps educators address the question, "*How do you incorporate technology to facilitate raw exploration of the natural world that reinforces inquiry-based learning in Environmental Education?*" By outlining different elements to create an inquiry based learning experience though backward design, teachers will be

able to critically analyze new or current classes and integrate technology possibly even into classes that already have been teaching.

Through step-by-step process, my overall goal was to create a simple framework that did not necessarily take a lot of previous knowledge on learning models to create new ideas and class material. I work with many current and new college students that are just going through the beginning stages of this learning. So It was important to me to help these new younger generations develop the new ideas and technology that they use and find their own connection to the educational field. This helps them grow as educators and our students stay in tune to the current skills sets of today's workforces.

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